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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/932,943	08/21/2001	Gaku Minamihaba	04329.2622	5394

7590 04/25/2003

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EXAMINER

LEE, HSIEN MING

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 04/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/932,943

Applicant(s)

MINAMIHABA ET AL.

Examiner

Hsien-Ming Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 February 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-37 is/are pending in the application.
- 4a) Of the above claim(s) 1-17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 18-28, 30-34, 36 and 37 is/are rejected.
- 7) ☒ Claim(s) 29 and 35 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other: _____

DETAILED ACTION

Remarks

1. The objection to specification and claim 22 is withdrawn in response to applicant's amendment filed 2/10/03.
2. Claims 1-37 are pending in the application. Of the above, claims 1-17 are withdrawn from consideration.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 30 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The limitation "colloidal silica particles whose primary particles have a diameter ranging from 5 to 30 nm ..." renders indefinite because it is unclear whether "colloidal silica particles" refers to "first colloidal silica particles" or "second colloidal silica particles."

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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6. Claims 18-21, 23-27, 30, 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wojtczak et al. (US 6,409,781) in view of Hudson (US 6,407,000).

In re claims 18, 23, 24 and 30, Wojtczak et al. in Figs. 1-3 and related text teach a method of manufacturing a semiconductor device, which comprises:

- forming a wiring groove on a surface of an insulating film 12 (a low dielectric constant film) formed above a semiconductor substrate 11;
- depositing a conductive material film, including a conductive barrier film 13 and a wiring material film 14, on a surface of said insulating film 12 including an inner surface of said wiring groove (Fig.1); and
- subjecting said conductive material film 13 and 14 to a chemical mechanical polishing by using a two-step slurry approach, comprising a first silica colloidal particles whose primary particles have a diameter ranging from 3 to 100 nm (col.5, lines 66-67) and a second silica colloidal particles whose primary particles have a diameter ranging from 3 to 100 nm as well (col.5, lines 66-67), wherein the particle range of the second slurry can be optimized and different from the first slurry, dependent upon the removal rate requirement of the conductive material film (col.8, lines 62-66), to remove the conductive material film 13 and 14 excluding a conductive material film portion which is buried in the wiring groove (Fig.2-3).

Wojtczak et al. do not teach subjecting said conductive material film 13 and 14 to a chemical mechanical polishing (CMP) using a slurry comprising *first colloidal silica* particles whose primary particles have a diameter ranging from 5 to 20 nm and *second colloidal silica* particles whose primary particles have a diameter *larger than 20 nm*, wherein the weight ratio of the first

colloidal silica particles is in the range of *0.6 to 0.9* based on a total weight of said first and second colloidal silica particles.

However, Hudson in an analogous art of chemical mechanical polishing (CMP) process teach utilizing a bi-modal slurry for planarizing a conductive layer, wherein the slurry comprising *first colloidal silica* particles whose primary particles have a diameter ranging from *0.010 μm (10 nm) to 0.050 μm (50 nm)*, and *second colloidal silica* whose primary particles have a diameter larger than 20 nm (i.e. *0.070 ~0.400 μm*) (col. 7, lines 10-15), wherein the weight ratio of the first colloidal silica particles is in the range of *0.6 ~ 0.9* based on a total weight of said first and second silica colloidal particles, as illustrated in Fig. 4, wherein 290 represents the size distribution of the first colloidal silica particles and 280 represents the size distribution of the second colloidal silica particles; and the ratio of 290 to 280 is within the range of 0.6~0.9.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to substitute the two-step CMP with mono-modal slurry as taught by Wojtczak et al. with the bi-modal slurry of Hudson since by this substitution it would simplify the CMP process and provide a selective planarization of the conductive material film to form a planar surface and maintain a high removing rate of the conductive material from the blanket surface (col. 7, lines 58-65, Hudson).

In re claims 19-21 and 25, Wojtczak et al. in view of Hudson teach all claimed limitations, i.e. the conductive material film 14 is a wiring material film, which is a copper film; and the conductive material film is a laminate film composed of two layers 13 and 14 comprising a conductive barrier film 13 made of at least one kind of materials selected from the group consisting of TiN, WN, Ta, and TaN (col. 3, lines 45-49, Wojtczak et al) and a wiring material

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film 14 (a copper film; col.3, line 49) laminated on the conductive barrier film 13; wherein the wiring material film 13 and 14 are subjected to the CMP by using the slurry (i.e. the bi-modal slurry).

In re claims 26 and 32, Wojtczak et al. in view of Hudson also teach that said polishing particles are incorporated in said slurry at a ratio of 0.5 to 5% by weight. (col. 6, lines 28-29, Wojtczak et al.)

In re claims 27 and 33, Wojtczak et al. in view of Hudson also teach that said slurry further contains an oxidizing agent and an oxidation inhibitor (i.e. corrosion inhibitor) to create a stable removal chemistry for the slurry and minimize undesirable corrosion to the conductive layer. (col.5, lines 30-33 and 43-50, Wojtczak et al.)

7. Claims 22, 28, 31, 34, 36 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wojtczak et al. in view of Hudson teach as applied to claims 18-21 and 23-25 above and further in view of Bruxvoort et al. (US 5,958,794).

In re claims 22, 31, 36 and 37, Wojtczak et al. in view of Hudson also teach that the conductive material film is a laminate film composed of two layers 13 and 14 comprising a conductive barrier film 13 made of at least one kind of materials selected from the group consisting of TiN, WN, Ta, and TaN (col. 3, lines 45-49) and a wiring material film 14 (a copper film; col.3, line 49) laminated on the conductive barrier film 13; wherein the wiring material film 13 and 14 are subjected to the CMP by using the slurry. In contrast, Wojtczak et al. in view of Hudson fail to teach that the slurry includes third particles formed of a material different from those of the first and second colloidal silica particles, to remove said conductive material film.

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However, Bruxvoort et al. in an analogous art of CMP teach utilizing a slurry containing a mixture of two or more different types of abrasive particles (col.20, lines 3-9) for the purpose of improving planarity and uniformity (col.2, lines 12-22); and the third particles can be colloidal alumina particles for altering the edodibility of the abrasive particles (col.21, lines 27-38 and lines 51-63).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to include third particles formed of a material different from those of the first and second colloidal silica particles as taught by Bruxvoort et al in the method of Wojtczak et al. in view of Hudson to remove said conductive material film since by doing so it would improve the degree of planarization (col.2, lines 12-22, Bruxvoort et al).

In re claims 28 and 34, Wojtczak et al. in view of Hudson teach all claimed limitations, as stated above, but fail to teach that the slurry contains a surfactant.

However, Bruxvoort et al. in an analogous art of CMP teach utilizing the surfactant in the slurry (col.20, line 66 through col.21,line15).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time the invention was made, to include the surfactant as taught by Bruxvoort et al in the slurry of Wojtczak et al. in view of Hudson since by doing so it would separate abrasive particles uniformly and prevent slurry settle down (or condensation) during the CMP.

Allowable Subject Matter

8. Claims 29 and 35 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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9. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record neither teaches nor suggests that the surfactant is dodecyl benzene sulfonate.

Response to Arguments

10. The arguments filed 2/10/03 have been fully considered but found not persuasive for the reasons as follow.

Applicants argue that the cited references do not show all the elements of the present invention; and there is no any suggestion or motivation to modify the cited references to results in the claimed invention. (page 8, third paragraph).

Contrary to the arguments, the combination of Wojtczak et al. in view of Hudson and further in view of Bruxvoort et al. teach all the claimed limitations as recited in claims 18-28, 30-34 and 36-37, as stated above. The motivations for the combination are: (1) forming a planar surface and maintain a high removing rate the blanket surface of the conductive layer; 2) improving planarization; and (3) keeping abrasive particles uniformly separate and preventing slurry condensation during the CMP.

Therefore, the Final rejection as set forth in this Office action is deemed proper.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kubo et al. to US 5,527,370 teach a bi-modal slurry.

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Taiwanese Patent Publication No. 428,023 teach utilizing a multi-modal slurry (e.g. Example 2) containing silica having particle size ranging from 10 ~200 nm and weight ratio of the silica particles in the range of 1~50%.

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a).

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

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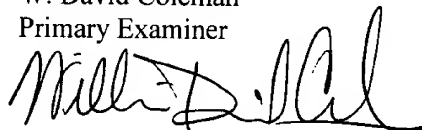
Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

HML

April 23, 2003

W. David Coleman

Primary Examiner

A handwritten signature in black ink, appearing to read 'W. David Coleman', written over the printed name and title.